Investigations of Tropospheric Ozone in the Northeast

ABSTRACT

This high altitude balloon project for near-space flight is part of an ongoing investigation of the concentration and distribution of ozone in the stratosphere and troposphere. The flight vehicle consists of a 600-1200 gram latex helium filled balloon which carries two separate instruments that measure the amount of ozone in the atmosphere and the temperature, humidity, altitude/ pressure, and dewpoint/frostpoint. We do this because we want to find out how much tropospheric ozone there is in relation to stratospheric ozone. These experiments are used as a ground verification of the Aura satellite which takes the same readings but from a top to bottom perspective. Then this information will be used to assess the effects of global warming and surface pollution transport to develop a strategies to target these problems.

TROPOSPHERIC OZONE

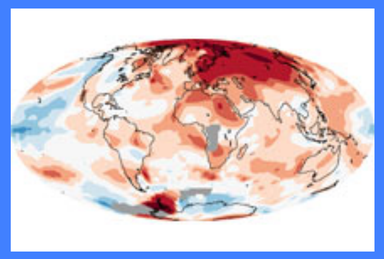
Tropospheric Ozone is ozone that is in the troposphere (between 1-14 km) and is a greenhouse gas and a pollutant. Abnormally high concentrations are brought about by human activities(the combustion of fossil fuels, industrial emissions, and chemical solvents). Ground level ozone (tropospheric) is a major problem causing health effects such as asthma respiratory infections and damage to lungs being formed from nitrous oxides, carbon monoxide, and other chemical compounds.

STRATOPHERIC OZONE

Stratospheric ozone is located between 18 to 50 kilometers above the surface of the earth, and most of the world's ozone is located here. Stratospheric ozone is considered the "good" ozone because it blocks harmful ultraviolet (UV) radiation from the sun. Unfortunately stratospheric ozone has decreased 3% globally between 1980-2000 and has thinned by 50% over Antarctica in winter and spring.

Aura Satellite

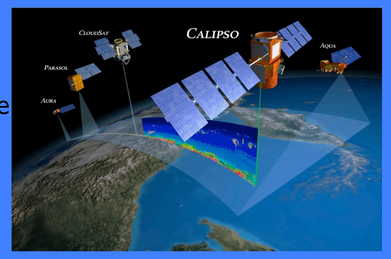
_Aura is a satellite that studies the chemistry and dynamics of our atmosphere from top to bottom. We send these balloons up to verify the data but from a bottom to top perspective. Aura (Latin for breeze) was launched July 15, 2004 .Aura is part of the Earth Science Projects Division, a program dedicated to monitoring the complex interactions that affect the globe using NASA satellites and data systems.



Aura has fulfilled its requirement for a five year lifetime and continues to provide high quality science data about our atmosphere . This data is being used to improve our knowledge of climate, air quality, and the physical and chemical processes
controlling the Earth's ozone layer. The Aura satellite uses a The Microwave Limb Sounder (MLS) which measure (naturally-occurring) microwave thermal emission from the limb (edge) of Earth's upper atmosphere. The data is used to create vertical profiles of atmospheric gases, temperature, pressure, and cloud ice.

(Balloon with payload before launch)

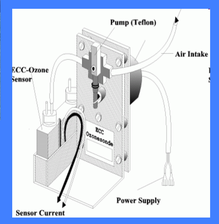
(Data begins to come through radio)



The new set of Nasa satellites that are replacing Aura featuring CALIPSO Cloud-Aerosol LIDAR and Infrared Pathfinder Satellite Observations which incorporates the lidar system to detect aerosols in our atmosphere

METHODS AND MATERIALS

Using a sounding balloon we can test the amount of ozone as a function of altitude. These balloons rise to about a height of approximately 27km at 5m/s . An ozonesonde is placed inside the payload which detects how much ozone is in the air. Rising through both the troposphere and stratosphere, it measures both tropospheric and stratospheric ozone and sends the data back through radio waves.



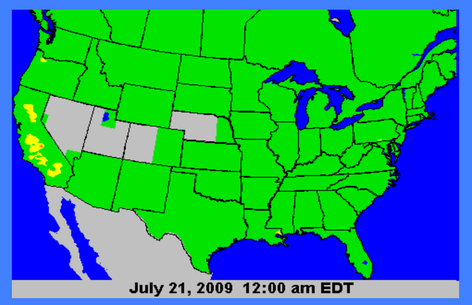
The Ozonosonde(at left)

The ozonesonde is an electrochemical concentration cell. Outside air enters and reacts with a diluted solution of potassium iodide. Then a weak electrical current is produced proportional to the ozone concentration of the outside air.

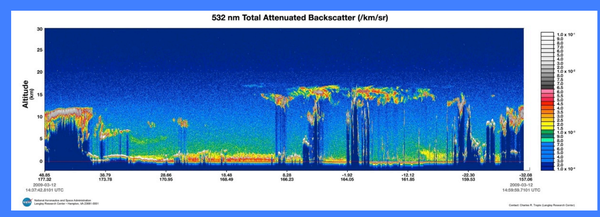
The Radiosonde (at left)

The radiosonde measures pressure, temperature, humidity, and dew point/frostpoint while the balloon rises and shows it relative to altitude. Then it sends data at a frequency of 403MHz back to our radio on the ground.

Surface Ozone of the United States



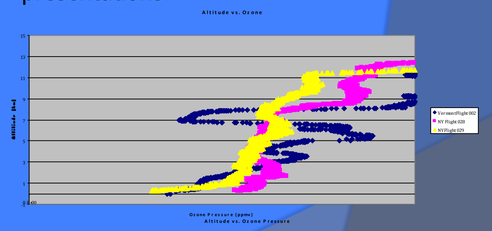
In addition to our sounding balloon test we also do surface ozone tests. Unlike the balloon which tests ozone as a function of altitude our surface ozone test show it at the the lowest level the ozone that directly affects our health.
In much of America surface ozone is about average. In this country wide pictures we see surface ozone spike over parts of California due to smog and forest fires. Even though it originates in California these pollutants affects the rest of the country.



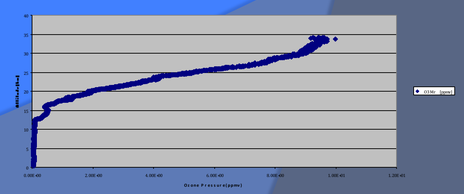
These are the results from the surface ozone test from the new Calipso satellite that uses a LIDAR system to tell what aerosols are in the air. This is the same improved system that I coincidently proposed in previous presentations.

RESULTS

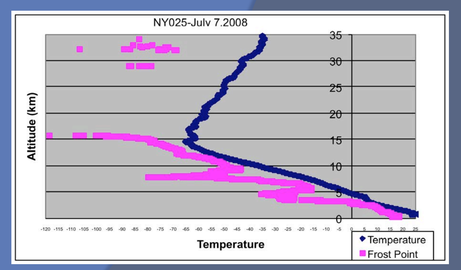
On the right is an ozone plot from 3 different launch dates. Altitude is shown on the left in kilometers while ozone is shown on the bottom in ppmv. This shows the amount of ozone in just the troposphere and tropopause. The amount is very low which is good because tropospheric ozone is a greenhouse gas. Even though these readings were taken in the same area, they differ slightly because of different weather conditions for each day.



These are the results from the most recent flight in Paradox, New York that shows the ozone data in the stratosphere and the troposphere. Here the ozone concentration is low in the troposphere and the concentration increases very fast in the stratosphere. On this day high humidity contributed to a decrease in the amount of ozone. On a day that is less humid there would be more ozone.



This chart shows one of the major weather conditions that affect the amount of ozone, humidity. When both temperature and frost point are near each other as in the Troposphere iindicicates a high degree of mixing causing increased humidity. This can be signs of high cloud density, increased updrafts and cross winds coming from the ocean.



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REFERENCES

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